AD-A053 593 ELECTRONICS ENGINEERING GROUP (1842ND) SCOTT AFB IL F/G 17/2
ADCOM DEDICATED SECURE VOICE.(U)
APR 78 C E SCHMIDT, B F BRIGNULL
UNCLASSIFIED 1842 EEG/EETS-TR-78-8 NL

| OF |
ADA
053593

END
DATE
FILMED
6-78
DDC

1842 EEG/EETS TR 78-8

(2)

TECHNICAL REPORT

ADCOM DEDICATED SECURE VOICE

SWITCHING AND CONTROL SYSTEMS BRANCH
1842 ELECTRONICS ENGINEERING GROUP (AFCS)
SCOTT AFB, ILLINOIS 62225

6 April 1978

1842 ELECTRONICS ENGINEERING GROUP

MISSION

The 1842 Electronics Engineering Group (EEG) is organized as an independent group reporting directly to the Commander, Air Force Communications Service (AFCS) with the mission to provide communications-electronics-meteorological (CEM) systems engineering and consultive engineering for AFCS. In this respect, 1842 EEG responsibilities include: developing engineering and installation standards for use in planning, programming, procuring, engineering, installing and testing CEM systems, facilities and equipment; performance of systems engineering of CEM requirements that must operate as a system or in a system environment; operation of a specialized Digital Network System Facility to analyze and evaluate new digital technology for application to the Defense Communications System (DCS) and other special purpose systems and equipment configurations to check out and validate engineering-installation standards and new installation techniques; providing consultive CEM engineering assistance to HQ AFCS, AFCS Areas, MAJCOMs, DOD and other government agencies.

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
1842 EEG/EETS-TR-78-8		

4. TITLE (and Subtitle)

ADCOM DEDICATED SECURE VOICE

5. TYPE OF REPORT & PERIOD COVERED

TECHNICAL REPORT,

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

CHARLES E. SCHMIDT AND BRUCE F. BRIGNULL

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS

1842 EEG/EETS
SCOTT AFB,IL. 62225

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS

SWITCHING & CONTROL SYSTEMS BRANCH
1842 EEG/EETS
SCOTT AFB, IL. 62225

12. REPORT DATE

6 APR 78

13. NUMBER OF PAGES

17

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

SAME AS BLOCK # 11

15. SECURITY CLASS. (of this report)

UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

UNLIMITED

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

UNLIMITED

18. SUPPLEMENTARY NOTES

NONE

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

SECURE VOICE

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A SURVEY OF THE ADCOM DEDICATED SECURE VOICE SYSTEM WAS CONDUCTED BY REPRESENTATIVES OF THE 1842 EEG IN ORDER TO INVESTIGATE AND RECOMMEND CORRECTIVE ACTION FOR THE PRESENT SYSTEM WHICH IS NO LONGER LOGISTICALLY SUPPORTABLE AND HAS A QUALITY OF VOICE REPRODUCTION NOT ACCEPTABLE FOR OPERATIONAL REQUIREMENTS.

409 646

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

APPROVAL PAGE

This report has been reviewed and is approved for publication and distribution.

DIVISION CHIEF: Z J Bara

ZYGMUND J. BARA

BRANCH CHIEF: Harvey A Bayless

HARVEY A. BAYLESS

PROJECT ENGINEER: Charles E Schmidt

CHARLES E. SCHMIDT

PROJECT ENGINEER: Bruce F. Brignull

BRUCE F. BRIGNULL

Summary

This report provides technical assistance to ADCOM on selection of a dedicated secure voice system which has significantly better supportability and intelligibility than the presently employed system.

A modified version of the AUTOSEVOCOM I narrowband subscriber terminal with all subscribers accessing the same AUTOVON switch is recommended.

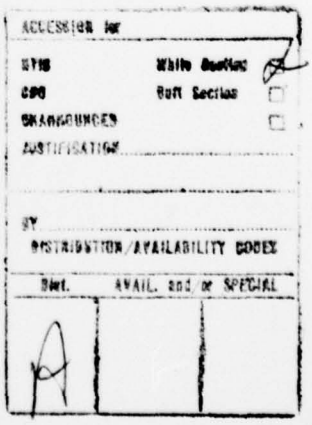

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

1. INTRODUCTION

1.1 In response to a request from the Air Defense Command (ADCOM) KRXP for technical assistance the 1842 Electronics Engineering Group, Switching & Control Systems Branch initiated a feasibility study to determine methods to satisfy ADCOM's requirement for an improved secure voice system.

1.2 The following features in order of importance were requested to satisfy ADCOM's operational requirements.

a. The system must be logistically supportable for a minimum of 10 years.

b. Intelligibility must be better than that obtained with the current KY-585 vocoders.

c. System call completion time must be 60 seconds or less.

d. A minimum of 2 levels of precedence.

e. A capability for 16 secure voice subscribers with 6 subscribers to be implemented initially.

f. Each subscriber shall have access to any other subscriber.

g. The system shall utilize the same type of transmission media as presently utilized.

h. Terminal equipment (except modems) to be installed in the Simplified Processing Station (SPS) shall not occupy more space than one standard equipment rack 75 inches high.

i. A back up switch is desired.

j. Capability to conference up to 6 subscribers is desired.

k. An automatic switch is desired.

l. AUTOSEVOCOM II compatibility is desired.

1.3 Subjective evaluation of the present system revealed that intelligibility was worse than expected for a channel vocoder like the HY-2 or KY-585.

2. SYSTEM CONFIGURATIONS.

2.1 Figure 1 is a diagram of the ADCOM dedicated secure voice network. Figure 2 is a functional block diagram of equipment configurations capable of providing secure voice communications. The configurations use different types of signaling and supervision. The equipments which can perform these functions are discussed in Paragraph 3. However, some system characteristics are determined by these configurations.

2.2 The configuration of figure 2A has a modem and key generator for each circuit at the switch which decrypts all signals in order to use digital signaling and supervision information for controlling the switch. Since this switch processes red information it must be located in a TEMPEST controlled environment. This configuration may provide a digital conferencing capability if the switch can perform the required logic functions. The presently installed system utilizes this configuration. Full duplex 4-wire circuits through the transmission media and switch are required. A master clock is required at the switch.

2.3 The configuration of figure 2B is used in the AUTOSEVOCOM I network. The switch is in a black TEMPEST environment. Conferencing is not available. The telephone initiates the call in the unsecure mode and can switch to the secure mode after communications with the distant end is established.

2.4 The configuration of figure 2C is a variation of figure 2B in that it has separate red and black telephones. 2B and 2C are interoperable.

3. EQUIPMENTS.

3.1 Speech Processors.

Speech Processors convert the analog voice signals to digital signals for encryption and transmission and convert the received digital signals back to analog. The primary criteria for evaluation of speech processors for this study are supportability and intelligibility better than the present system which utilizes KY-585 vocoders. Diagnostic Rhyme Test (DRT) scores are used in this report t compare intelligibility of the speech processors (ref 1).

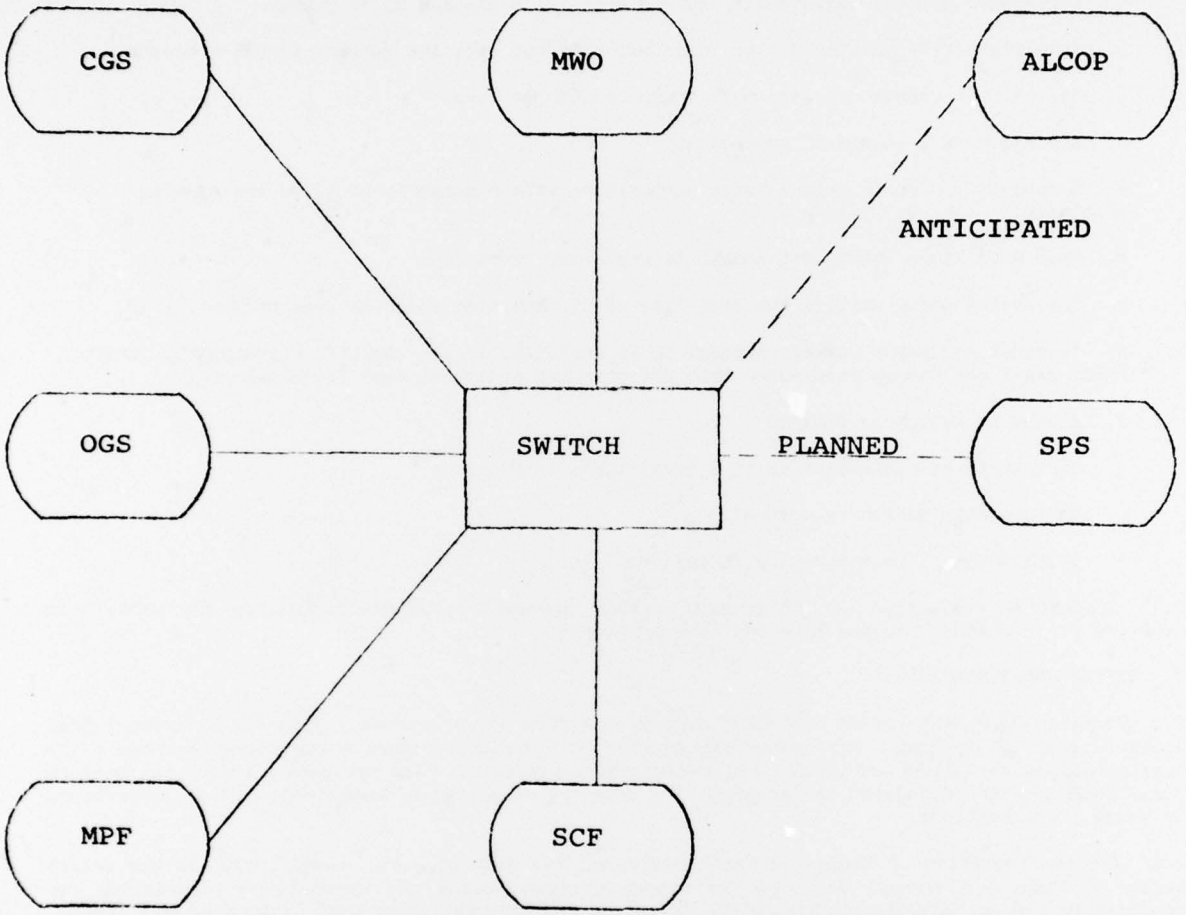

Figure 1. ADCOM Dedicated Secure Voice Network

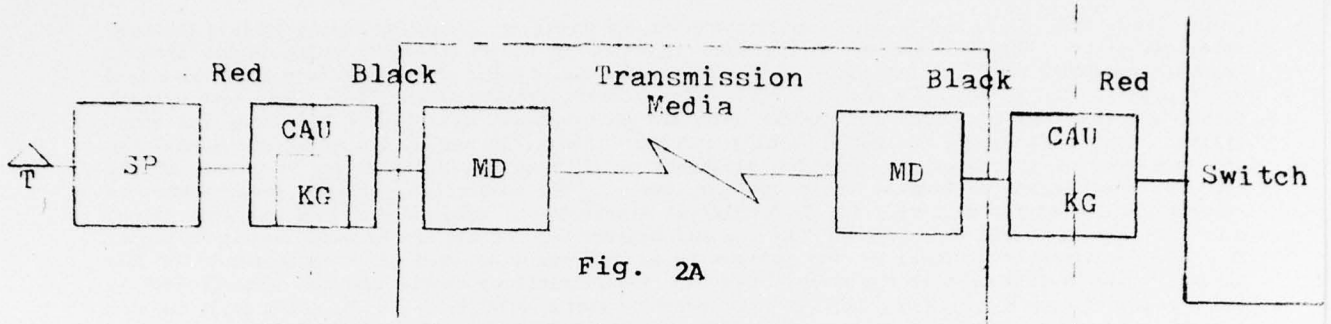

Fig. 2A

Leased in CONUS

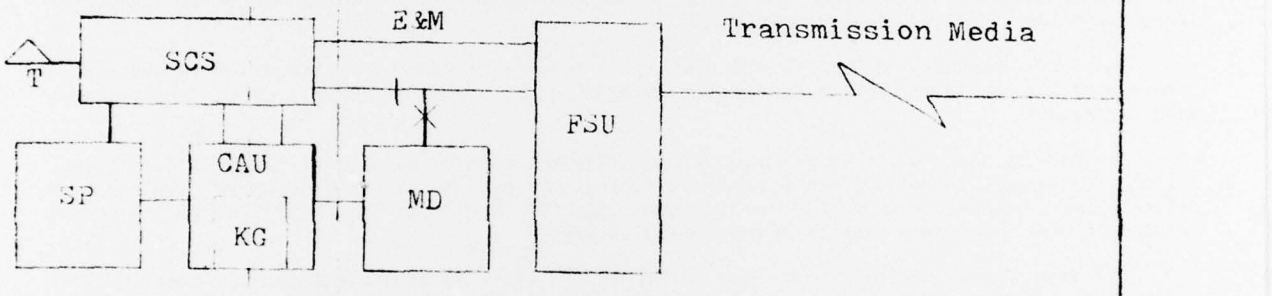

Fig. 2B

Switch

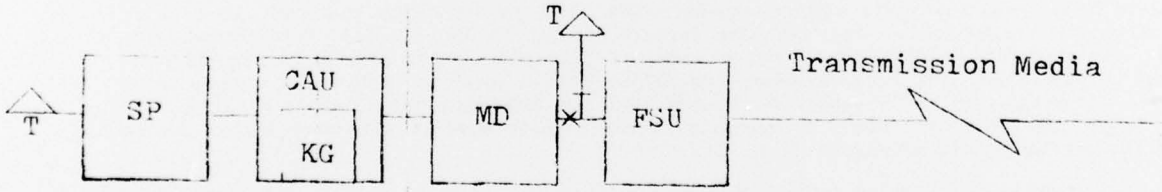

Fig. 2C

LEGEND:
T Telephone
SP Speech Processor
MD Modulator Demodulator (Modem)
KG Key Generator
CAU Crypto Ancillary Unit
SCS Switching & Control Subsystem
FSU Frequency Signalling Unit

Figure 2. Secure Voice Equipment Configurations

3.1.1 The KY-585, HY-2, and CV-3333 vocoders are interoperable and should by design achieve the same intelligibility. The DRT score for the HY-2 is 85.3% in a back-to-back configuration without transmission media (ref 2). Introduction of transmission media would normally reduce this score by 2 or 3% points. The KY-585 is a small, light-weight aircraft version of the HY-2. They both extract pitch, spectrum and amplitude information from the voice signal by multiple filtering and quantizing. This information is then digitally encoded. Since the analog filtering and quantizing circuits require extensive and detailed alignment which must be identical on both ends of the circuit, they seldom perform at their optimum level. They produce a synthetic speech which is speaker and listener sensitive. The CV-3333 first digitizes the voice signal then extracts pitch, spectrum, and amplitude information. The only maintenance adjustments are to power supply voltages. The CV-3333 normally performs at the optimum level and could be used as a replacement for the unsupportable KY-585s used in the present system. Intelligibility should improve. The CV-3333 is being procured from E systems by NAVELEX under contract number N00039-77-C-0126. Life cycle support availability and delivery schedules can be obtained from NAVELEX Code 10, AV 222-8365.

The CV-3333 fits in 10½" of rack space. Mean time between failures (MTBF) is specified at 2000 hours and mean time to repair (MTTR) is specified at 20 minutes. The unit contains built in test equipment. Estimated cost is $15K.

3.1.2 Time and Space Processing, Inc. claims a DRT score of 92.1% in a back-to-back configuration for their Model 100 speech processor. The government has not officially tested the TSP-100. Aeronautical Systems Division XOG, AV 785-6465, has ordered two TSP-100s. AF COMSEC Center, AV 9452037, plans to perform TEMPEST test on these units. Caution is urged in purchasing any speech processor which has not undergone extensive testing in an operational environment. It is possible for speech processors to sound excellent in demonstrations but poor in field applications. Intelligibility depends upon many variables.

The intelligibility of the TSP-100 appears to be clearly superior to other narrowband speech processors but should be field tested as much as time and resources will permit prior to procurement and employment.

The TSP-100 has a built-in diagnostic capability and a predicted MTBF of two and a half years. Life cycle support is not currently available from within the DOD. Estimated purchase cost is $15K each in small quantities or $600 per month lease. The TSP-100 fits in 5½" of vertical space in a 19" equipment rack. Delivery time is approximately 90 days.

The Naval Ocean Systems Center Code 8143, AV 933-6143, is investigating the possibility of upgrading their Automated Digital Switch (ADS) by using the TSP-100 to replace Vadac IIIs which have poor intelligibility.

3.1.3 The Parkhill KY-75 contains a speech processor, a key generator, and a modem all in one package. Its DRT score is 81.7% in a back-to-back configuration (ref 2). Its primary application is for securing high frequency radio communications. NSA CSESD-15 indicates that DRT scores will average 10% less than DRT scores over the same circuit without KY-75s. An important transmission circuit parameter for the KY-75 is frequency response specified from 300 to 2700 Hz within 3dB. The D-1 circuit parameter for frequency response from 300 to 3000 Hz is +8 to -2 dB which appears to be inadequate. Although the KY-75 cannot be recommended for improving intelligibility it is the smallest device considered and since it operates in half duplex mode it will work with a 2-wire switch in the configurations of figure 2B or 2C.

3.1.4 The HY-11 DRT score is 75.5% in a back-to-back configuration at 9.6 KBS (ref 2). Since the intelligibility of the HY-11 is clearly inferior it will not be considered further.

3.1.5 The VINSON KY-58 contains a speech processor and key generator in one package and has DRT scores ranging from 90.9 to 94.7% over UHF radio (ref 3) with a data transmission rate of 16 KBS. A 16 KBS modem is required for transmission of the KY-58 signal over telephone circuits. A 16 KBS modem is being developed for RADC/DCLD by Harris Corporation. (ref 4). The modulation, demodulation, decision and automatic equalization concepts have been proven but the tested engineering prototype did not contain control functions. The military version which costs $8K, is scheduled to be available in 1981. Harris indicates they can have a commercial version, model 5238, available in 9 months. Initial production will be in their engineering laboratory. The commercial version will fit in 7" rack space and cost $30K each. Model 5238 is an advanced development model of the engineering breadboard which was tested for RADC. The model 5238 would require extensive system testing and analysis to determine its performance and reliability before we could recommend it for implementation.

3.2 Switches.

3.2.1 AUTOVON: The CONUS AUTOVON network uses leased 4-wire switches. These switches have a proven in-service record and are highly reliable. Their capabilities include (1) a precedence/preemption capability, (2) matrices designed to meet stringent wideband switching requirements, (3) a

nonblocking CONUS network for precedences at or above the Flash level, (4) an "off-hook" hotline capability, (5) abbreviated dialing, and (6) a rotary hunt capability. Some of the switches are hardened.

There are two configurations in which the CONUS AUTOVON network can be used to satisfy the ADCOM Dedicated Secure Voice requirement. The first involves homing all subscribers to the closest AUTOVON switch and the second involves homing all subscribers to the same AUTOVON switch. In either case, the prime requirement is to justify a CONUS Flash or Flash Override precedence to assure a nonblocking connection when required. This justification must be based on mission requirements. High restoration priorities are also required. The AUTOVON numbers would not be published.

The fastest connection is an "off hook" (hot line) capability. This limits the user to accessing only one location. An abbreviated dial capability also reduces the time required to make a connection, masks the use of the AUTOVON system, and allows each subscriber to access any other subscriber. The rotary hunt capability permits installation of more than one line at the MWO so that each of the other subscribers with a Flash or higher precedence is assured of accessing the MWO.

If all subscribers were homed on the same AUTOVON switch, the Lamar, CO installation would be recommended. It is one of the newer switches (installed in 1967), has a good operating record with no outages, and is installed in a hardened site. Sufficient subscriber line terminations are available.

Disadvantages associated with using the CONUS AUTOVON network are (1) ADCOM relinquishes direct control of the switching equipment, (2) there is a possibility of future AUTOVON subscriber and backbone cost increases, (3) DTMF signaling in the clear is required and (4) there is no secure conference capability.

3.2.2 Two-Wire Switch: North Electric Company manufactures a small electronic switching system called the NX-63. It is advertised as a four-wire switch, but the subscriber terminations are two-wire. If a two-wire switching system is selected, the NX-63 is the most cost effective switch identified. The basic NX-63 unit is expandable in increments of three to a maximum of 27 subscribers and is designed to mount in a standard 19 inch rack (height 10.5 inches, depth 12.75 inches). The NX-63 consists of plug-in cards which comprise the central processor unit, matrix, receiver/sender unit and subscriber line terminations. A power supply included in the basic unit provides all required voltages, tones, system timing and ring generation. This power supply requires an input voltage of 48 VDC at 2 amps.

The NX-63 provides full consoleless subscriber to subscriber service. The matrix has ten links and is therefore essentially non-blocking up to 20 subscribers. An executive or emergency override is available which provides two levels of precedence. In the configuration being described, the NX-63 is an off-the-shelf item, already in operation, with a 90 day availability and a 10 year supportability period. Cost is approximately $9,000. The Army has purchased some of these units for NATO.

The maintenance concept involves replacement at the card level. Card repair should be contracted to the manufacturer. The basic unit consists of seven plug in cards plus one additional card for each three subscribers. The microprocessor has a very limited diagnostic capability which is tied to a run lamp. The routine maintenance effort would consist of placing scheduled test calls to verify system operation for each subscriber and a coordinated set of calls to verify the preempt capability. The processor run lamps would be periodically checked.

Advantages of the NX-63 are: fully electronic consoleless operation, read only memory (ROM) which eliminates tape system reloads, small size, no PMI (relay adjustments, lubrication, etc.) and limited amount of training required for maintenance and user personnel.

Disadvantages of the NX-63 are: 4 digit DTMF signaling in the clear is required, no conferencing, no automatic transfer capability to ALCOP, no audible alarm if the processor stops (run lamp and power lamp provided), and no precedence (4-wire use only).

3.2.3 Four-Wire Switch: No entirely satisfactory 4-wire switch has been identified. The only 4-wire GFE switch still in production is the Western Electric Company (WECO) 758C PBX. WECO indicates the 758C meets all requirements listed in para 1.2 above. However, the switch represents the earliest common control switch technology, would require a high level of maintenance effort for the number of lines involved, would require space for 7 to 10 frames of equipment, and could cost $750,000. It was, therefore, eliminated from consideration.

3.2.3.1 The major telephone switching system manufacturers use 4-wire systems for tandem switching. These systems are too large and expensive for the application being considered. DCA indicated that their current preference for the AUTOSEVOCOM II DAX switch is the TRW Vidar ITS-4. TRW Vidar revealed their DAX effort is presently HIA. The ITS-4 is a large 4-wire PCM switch designed to be a Class 4 or 5 office. Exactly how much of the standard ITS-4 hardware configuration and softwar

would be used for a DAX switch is not clear. For the ADCOM requirement a stripped down ITS-4 would still require five frames of equipment, costing approximately $120,000. The precedence/preemption, transfer to ALCON and conference software would have to be developed. Availability is not possible before the first or second quarter of 1979. However, the development of new software could extend the availability date. The system would be implemented by having the subscribers appear on the 4-wire tie trunks rather than on the line termination. Signaling would be DP or DTMF.

Advantages of the ITS-4 are: possible AUTOSEVOCOM II compatibility, dual processor configuration and extensive diagnostic capability.

Disadvantages of the ITS-4 are: cost, size, signaling (DP or DTMF) in the clear and extensive training of personnel.

3.2.3.2 The North Electric Company NX-63 could also be used as a 4- wire switch by having the subscribers appear on trunk terminations rather than on the 2-wire line terminations. In this configuration the precedence/preemption capability is lost.

3.2.3.3 Another class of 4-wire switching system is available from software development companies. Their approach is to use a commercially available general purpose processor rather than one developed specifically for telephone switching and perform all switching functions within the software. The advantage to such an approach is the compactness of a system designed specifically to interface with the terminal equipment. The disadvantages include (1) a learning curve on call processing techniques and (2) supportability (supplier does not control the hardware). Therefore, the supplier must be required to meet extensive prototype and field acceptance tests on the entire system. One such system is the Automated Digital Switch (ADS) developed by Analytics under Navy Contract No. N00039-76-C-0464. The ADS provides secure, automatic switching featuring direct dialing, multilevel precedence calling and preemption, multiline conferencing, camp-on busy and unattended operation. Estimated system cost for the ADCOM application is $350K (includes terminal equipment but not transmission media). The ADS in its present configuration is experiencing severe activation problems including hardware, software and overall system problems. These problems have not been resolved to the Navy's satisfaction. The Navy ADS is based upon the Honeywell H716 which is widely employed by the WWMCCS program. The H716 is normally government owned and contractor maintained. The H716 appears to be far more powerful than needed for this system and minicomputers based on more recent technology possess greater reliability and self diagnostic capability. A major advantage of the H716 could be the direct application of the computer programs from the Navy ADS.

3.2.4 Switch Summary: No manufacturer with an intelligible, automatic, off-the-shelf, secure voice switching system has been identified. Possible sources for such a system are the suppliers of the major subsystems such as secure voice terminal manufacturers, switch manufacturers or software orientated companies. Therefore, there are several potential sources for the system, but each source will have to engage in some degree of development and interfacing to produce a complete system. For this reason (if a system is to be procured) it is recommended that the entire system be competitively procured from a single source. The contract must be very strong with regard to intelligibility, overall system performance, supportability and delivery dates. Provisions should be made for performance accessment at the prototype stage and for extensive field testing prior to acceptance.

3.3 Signaling and Supervision

3.3.1 The digital signaling of figure 2A can be implemented as an optional feature on the TSP-100 and E systems has a digital signaling device for use with their Vadac speech processors. The present system originates digital signaling and supervision in the vocoder control panel.

3.3.2 The control function in figure 2B can be provided by the SA-1635 Switching and Control Subsystem (SCS) and the TA-814 Dual Tone Multi Frequency (DTMF) telephone which are standard equipments used in the AUTOSEVOCOM network. These equipments are procured and supported by the U.S. Army Communications Systems Agency/CCM-SW-C, Ft. Monmouth, N. J.. It may be possible to procure SA-1635s and TA-814s or borrow them from other programs. Estimated cost of the SA-1635 is $9K and the TA-814 is $1.5K.

3.3.3 Figure 2C is implemented with a standard AUTOVON telephone and a transfer switch which can be leased from the telephone company. This configuraton has the disadvantage of requiring two telephones.

3.3.4 The frequency signaling unit in figure 2B and 2C provides standard E&M signaling and can be leased from the telephone company in the CONUS or WESCOM 400 series equipment can be purchased. The latter equipment is readily available and is currently being introduced into AUTOSEVOCOM I.

3.4 Transmission Media.

The following leased services and equipment are required to implement configuration 2B with an

AUTOVON switch.

a. Charges for TELPAK Mileage from each of the six subscriber sites to the Lamar, Co AUTOVON switch:

(1) $590.79 per month
(2) $618.81
(3) $455.93
(4) $ 97.50
(5) $ 76.48
(6) $100.41

b. Equipment monthly recurring charges (MRC) at the AUTOVON switch for each of the six subscriber sites:

USOC Code	MRC	Installation charge
A4W (Preempt)	$19.64	
AKB (Access Line)	$56.41	
TP3 (Svc Term)	$43.73	$54.69
P7W (C3 Condition)	$15.05	
1HU(Abbreviated Dial)	$52.47	$392.89

c. Equipment charges at each of the subscriber sites:

USOC Code	MRC	Installation charge
8FS (Dial Argt)	$ 5.45	
TP3 (Svc Term)	$ 43.73	$ 54.69
P7W (C3 Condition)	$ 15.05	
TTC (Addl Svc Term for V Ckt)	$ 21.87	$ 54.69
96T (WECo 209 Modem)	$251.49	$ 218.16
ALF (Int Subset Sync)	$ 2.42	$ 54.69
1YX (Switch Argt)	$ 1.11	

d. CONUS AUTOVON Subscribers Rates:

SR Code	Precedence	MRC
3E	Flash	$1,012.00
3F	Immediate	$ 759.00

3.5 Crypto.

The present system has dual KG-13s installed with SN-394 Crypto Ancillary Units (CAU) which are automatic synchronizers. They are reliable and supportable, but the complete secure voice terminal does not fit in one equipment rack which is an SPS requirement. Two KG-34s with a dual UYK-22 (CAU) will fit in one rack with redundant speech processors, control and interface equipment. Availability of KG-34s to support this program can be determined by contacting the Air Force Cryptographic Depot. The UYK-22 is supported by Sacramento Air Logistics Center.

4. COMPARISON OF CONFIGURATIONS.

4.1 The recommended secure voice system is similar to the AUTOSEVOCOM I system and consists of the configuration of figure 2B implemented with two each (redundant) CV-3333 speech processors, one each TA-814, one each SA-1635, one each UYK-22, two each (redundant) KG-34s, two each (redundant) leased WECO 209 modems, a leased frequency signaling unit and AUTOVON access lines to the Lamar, Co switch. If a backup switch is desired, then lease AUTOVON access lines to a second switch. All of the equipment except the modems will fit in one equipment rack. Flash or immediate precedence plus four digit DTMF dialing will meet the call completion time requirement. The intelligibility of the CV-3333 is adequate; however, a demonstration of the CV-3333 is recommended. This system uses transmission media similar to that specified and can be expanded to include additional subscriber . AUTOSEVOCOM II compatibility and conferencing are not available with this system.

4.1.1 Estimated cost for secure voice system with six subscribers:

Government furnished equipment	$424,200
AFCS Engineering	44,900
AFCS Installation	50,100
Installation of leased equipment	6,300
Total Implementation Cost	$525,500
Annual recurring charge for transmission media and switch	140,160

4.1.2 Implementation of the secure voice system can be programmed by preparing a statement of requirements in accordance with AFR 100-18.

4.2 A system worthy of consideration is the configuration of figure 2A implemented with the TSP-100, UYK-22, KG-34s, WECO 209s, and D-1 dedicated circuits to an ADS. The Naval Ocean Systems Center Code 8143 is making improvements on the ADS and may be able to assist in developing a system for ADCOM. AFCS can fund the development engineering for this system. This is the only system which provides a conferencing capability. This system provides ideal operational characteristics but has the disadvantages of high cost, long time to develop and nonavailability of logistics support for the TSP-100.

4.3 A system utilizing the KY-75 in the configuration of figure 2B or 2C is the smallest and simplest considered but can't be recommended to improve intelligibility.

4.4 A system utilizing the KY-58 in the configuration of figure 2B or 2C is small and may be the most intelligible but depends upon the 16KBS modem which is not yet ready for implementation.

REFERENCES

1. AFCRL-72-0694 "Research on Diagnostic Evaluation of Speech Intelligibility"

2. Narrowband Digital Voice Processor Consortium Final Report

3. VINSON Test Report

4. Report F30602-76-C-0460 16 Kilobit Modem Evaluation, 77 July

LIST OF ACRONYMS

ADCOM	Air Defense Command
ADS	Automated Digital Switch
AFCS	Air Force Communications Service
AFR	Air Force Regulation
ALCOP	Alternate Command Post
AUTOSEVOCOM	Automatic Secure Voice Communications
AUTOVON	Automatic Voice Network
CAU	Crypto Ancillary Unit
CEM	Communications-Electronics-Meteorological
CGS	CONUS Ground Station
CONUS	Continental United States
CSESD	Communications Security Engineering Systems Document
DAX	Digital Access Exchange
DCS	Defense Communications System
DOD	Department of Defense
DP	Dial Pulse
DRT	Diagnostic Rhyme Test
DTMF	Dual Tone Multi Frequency
GFE	Government Furnished Equipment
HIA	Held in Abeyance
KBS	Kilobits per Second
MAJCOMs	Major Commands
MPF	Multi Purpose Facility
MRC	Monthly Recurring Charges
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
MWO	Missile Warning Officer
NATO	North Atlantic Treaty Organization
NSA	National Security Agency
OGS	Overseas Ground Station

PBX	Private Branch Exchange
PCM	Pulse Code Modulation
PMI	Preventive Maintenance Inspection
RADC	Rome Air Development Center
ROM	Read Only Memory
SCF	Satelite Control Facility
SCS	Switching and Control Subsystem
SPS	Simplified Processing Station
TSP	Time and Space Processing
UHF	Ultra High Frequency
USOC	Uniform Service Order Code
VDC	Volts Direct Current
WECO	Western Electric Company
WWMCCS	Worldwide Military Command and Control System

DISTRIBUTION:

ADCOM/KRXP.....8

1844 EES/EPEG.....2

1843 EES/EIE.....2

HQ AFCS
- EPPB.....1
- DAPL.....2
- EPE.....2

DDC,Cameron Station, Alexandria, Va.....2